

**Final**  
**Total Maximum Daily Load**  
**for the Susquehanna River,**  
**PCBs**

**PA Route 92 bridge at Falls to  
confluence with West Branch Susquehanna River  
March 12, 1999**

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**Introduction**

Pennsylvania has conducted monitoring of fish tissue contaminants since 1976. Early efforts were comprised of special studies in major water bodies as well as smaller waters with suspected sources of contaminants. Routine sampling for tissue contaminants began in 1979 with implementation of the EPA "CORE" monitoring network that mandated collection of whole fish samples. Because Pennsylvania wanted the fish tissue monitoring program to focus on protection of public health, we began sampling both the edible portion and whole body at one-half of the stations. In 1987, Pennsylvania began sampling the edible portion almost exclusively. In order to increase spatial coverage, we also began rotating sampling through our routine ambient monitoring network and

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provided both Department of Environmental Protection (DEP) and Fish and Boat Commission field biologists the opportunity to sample suspected problem areas.

Fishing is a wholesome, relaxing pastime, and fish are nutritious and good to eat. Some fish, however, may accumulate contaminants to levels that may be harmful to those who eat them over a long period of time. In an attempt to protect public health, the Commonwealth periodically (at least annually) issues fish consumption advisories based on monitoring data from a number of sources. Advisories are issued jointly by the Department of Health, the Fish and Boat Commission, and DEP. The list of advisories is published in the "Pennsylvania Summary of Fishing Regulations and Laws" which is provided to each fishing license buyer, and is also available from the Department in hard copy and through the Internet. In addition, the annual list and any individual advisories needed between lists are issued using press releases.

A number of Pennsylvania waterbodies with fish consumption advisories were listed on the Clean Water Act Section 303(d) List of Impaired Waters for 1996. They were listed because long-term, unrestricted consumption of these fish could potentially lead to human health problems. This document addresses contamination of fish tissue in the Susquehanna River by PCB. The fish consumption advisory segment flow through or adjacent to Wyoming, Lackawanna, Luzerne, Columbia, Montour, and Northumberland Counties.

### **Background**

This Total Maximum Daily Load (TMDL) applies to the main stem of the Susquehanna River (Stream Code 06685) from the PA Route 92 bridge at Falls (River Mile 208.8) to the confluence with the West Branch Susquehanna River (River Mile 125.5). This segment was included on the 1996 Section 303(d) list in State Water Plan Watershed 5-B as a low priority. It was also included on the 1998 303(d) list in State Water Plan Watersheds 5-B, 5-D, and 5-E (Segment ID 9914) as a high priority for TMDL development.

The first advisory for this segment was issued March 17, 1992 due to PCB concentrations of 2.7 - 2.9 parts per million (ppm) in shorthead redhorse. These levels exceeded the 2.0 ppm FDA Action Level used to trigger PCB advisories at that time. The segment limits at that time were from Pittston to the village of Hunlock Creek. The "Do Not Eat" advice was expanded to include additional bottom feeding fish - other suckers, carp and quillbackcarpsucker - in an effort to limit exposure. The advisory for bottom feeders was reissued January 12, 1993 based on new data that again indicated PCB above 2.0 ppm in shorthead redhorse. Follow-up sampling was conducted to include game species, and application of the Great Lakes protocol for the 1998 advisory resulted in meal-specific advice and inclusion of walleye and smallmouth bass to the species list. In addition, the segment limits were expanded in an effort to provide maximum protection to the angling public.

### **TMDL Development**

#### **Endpoint Identification**

The overall goal of a TMDL is to achieve the "fishable/swimmable" goal of the federal Clean Water Act. Because consumption advisories are in place for bottom feeding fish, walleye, and smallmouth bass, these goals are not being met in this segment of the Susquehanna River.

The specific goal of a TMDL is to outline a plan to achieve water quality standards in the water body. For this segment of the Susquehanna River, the TMDL goal is for level of PCB in the water column to be equal to or less than the Commonwealth's water quality criterion from the "Water Quality Toxics Management Strategy – Statement of Policy" (Chapter 16 of the Departments rules and regulations). The human health criterion for PCB in Chapter 16 is

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0.00004 µg/L (micrograms per liter, equivalent to parts per billion). PCB is a probable human carcinogen, and this is a human health criterion developed to protect against excess cancer risk. Specifically, the Department's water quality toxics management program controls carcinogens to an overall risk management level of one excess case of cancer in a population of 1 million (1 x 10<sup>6</sup>). Expressing this another way, the probability of an individual getting cancer is increased by a factor of 1 in 1 million.

Two means were employed in an effort to obtain readily available data on stream PCB levels for comparison to the criterion. First, the Department's Northeast and Northcentral Field Offices were asked to search for PCB data in or upstream from the Susquehanna River fish consumption advisory segment. That search failed to produce any instream data. Second, data from the EPA Storage and Retrieval System (STORET) was obtained. Several "Inventory" retrievals that would include data collected by all agencies using STORET were run for areas around the Department's fish tissue sampling stations and an additional location to provide complete coverage. The locations included Water Quality Network (WQN) Station 301 at Danville, WQN 302 at the Retreat State Prison, WQN 303 near Pittston (discontinued), WQN 323 at Falls, and a site at Lime Ridge. Two locations with PCB data were found, but the samples were collected between 1974 and 1986. This data does not represent current conditions.

As a means to compare current conditions to the water quality criterion, an estimated water column concentration was calculated based on the fish tissue concentration and a bioconcentration factor. The calculation involves dividing the average fish tissue concentration by the bioconcentration factor to obtain a projected water column concentration. The equation is:

$$\frac{TC}{BCF} = WC \times 1000$$

TC = Tissue Concentration in mg/kg (equivalent to mg/L)

BCF = EPA Bioconcentration Factor in L/kg

WC = Water Column Concentration (estimated) in mg/L

Multiply by 1000 to obtain µg/L

The average fish tissue concentration is the mean of all samples. The average concentration is used for two main reasons. First, the fish tissue samples are composites. This means that the sample result represents the average tissue concentration in two to five individuals, and not an exact value. Second, use of an average value considers the natural variation in tissue burden found in wild fish populations. The PCB Bioconcentration factor (BCF) of 31,200 from the EPA criteria development document (EPA 440/5-80-068, October 1980) was used. This BCF was used because no Bioaccumulation Factor (BAF) is available for statewide use. The use of the BCF is consistent with the provisions of the Department's water quality toxics management strategy. An estimated water column concentration was calculated for each species. These were then averaged in order to provide a single estimated concentration for the segment.

The average PCB concentration in fish tissue from this segment of the Susquehanna River is 0.8604 ppm. The estimated concentration of PCB in the water column is 0.02758 µg/L. This estimated concentration exceeds the water quality criterion. This value most likely does not represent the actual existing instream concentration due to the basis for the back-calculation. The back-calculation from tissue level to water column concentration was performed using data on species for which consumption advisories have been issued, i.e., fish with elevated tissue levels of PCB. It must be noted that some of the average tissue concentrations may be artificially elevated because of the use of one-half of the detection limit for data reported as less than detection. The actual

concentration could lie anywhere between zero and the detection limit. The use of one-half of the detection limit is merely a means of obtaining a reasonable value to use in calculating the average. While the actual concentration in the water column is not known, it is likely to be lower than the calculated estimate.

### **Source Assessment**

The production and use of PCB in the United States was banned in July of 1979. While it is now illegal to manufacture, distribute, or use PCB in the United States, these synthetic oils were used in the past as insulating fluids in electrical transformers and other products, as cutting oils, and in carbonless paper. PCB was introduced into the environment while their use was unrestricted, and occasional releases still occur. In addition, some permitted discharges and Superfund sites contribute PCB to surface water. Once in a waterbody, PCB becomes associated with solids particles and enters the sediments. PCB is very resistant to breakdown and thus remains in river and lake sediments for many years. Fish are exposed to and accumulate PCB from the water, through contact with or ingestion of sediments, and in the food they eat.

Two methods were employed in order to locate known sources of PCB to this segment of the Susquehanna River. First, the Northeast and Northcentral Field Offices were asked to provide information on known existing or historical sources that might contribute PCB in or upstream from the fish consumption advisory reach. For any known sources, they were requested to provide the name and location as well as flow rate and the long-term discharge concentration (to help establish load). Neither field office was aware of any potential sources. Second, the EPA Permit Compliance System (PCS) database was searched for any major discharge permits containing PCB as an effluent limitation. While one discharger was found on the PCS database, it appears that the only requirement was to monitor and report on PCB levels in a storm water induced discharge from a coal and/or fly ash storage area. All reported monitoring data was below detection (1990 through 1994). Staff in the Northcentral Field Office researched the file and did not find any PCB effluent limitations in the permit.

### **TMDL Calculation**

Development of TMDLs includes consideration of background pollutant contribution, appropriate and/or critical stream flow, and seasonal variation. The natural instream background concentration of PCB is assumed to be zero because it is a man-made compound and there are no natural sources.

PCB is a probable human carcinogen. Carcinogenesis is a nonthreshold effect, an adverse impact that may occur at any exposure greater than zero. Such an effect is often related to long-term exposure to low levels of a particular chemical or compound, rather than an immediate effect due to a short duration exposure to a high level. As noted earlier, the Department's water quality toxics management program uses a cancer risk level of  $1 \times 10^{-6}$  to protect human health. Attainment of this risk level is predicated on exposure that includes drinking 2 liters of water and ingesting 6.5 grams of fish per day over a 70-year lifetime. The Department uses harmonic mean flow as the appropriate design condition for dealing with exposure to carcinogens. This is a long-term flow condition that will, when applied to the Total Maximum Daily Load, represent long-term average exposure. Because seasonal increases and decreases in concentration are less important than the long-term exposure to a carcinogen, use of harmonic mean flow adequately considers seasonal variations in PCB concentrations.

The calculation of the Susquehanna River TMDLs uses the water quality criterion and flow data from the U.S. Geological Survey surface water discharge station just upstream from The PA Route 54 bridge at Danville (01540500). The harmonic mean flow was calculated using the low flow yield method found in the Department's "Implementation Guidance - Design Stream Flows" (Document No. 391-2000-023, p 4). This method requires that the harmonic mean flow (Q<sub>hm</sub>) from the USGS gage used be divided by the gage drainage area to arrive at a UnitQ<sub>hm</sub> that is multiplied by the drainage area of the segment to

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produce a Segment Qhm in cubic feet per second (cfs). The Segment Qhm for the Susquehanna River is 6616.92cfs.

The Segment Qhm is used in calculating the Total Daily Maximum Load (TMDL) by multiplying it by the water quality criterion and a multiplier to convert from cfs x µg/L to lbs/day (pounds per day). The PCB TMDL is calculated as follows:

$$6616.92 \text{ cfs} \times 0.00004 \text{ µg/L} = 0.2646768 \text{ cfs} \times \text{µg/L} \times 0.00539 = 0.0014266 \text{ lbs/day.}$$

The Total Maximum Daily Load of PCB for the Susquehanna River is 0.0014266 pounds per day.

### **Percent Reduction**

The goal of this TMDL is to achieve the water quality criterion in order to protect public health. In order to achieve this, the stream concentration must be reduced from the estimated current level of 0.02433 µg/L to the criterion, which is 0.00004 µg/L. Percent reduction is calculated using the following formula:

$$\% \text{ Reduction} = (1 - \text{TMDL Goal/ Existing Concentration}) \times 100$$

$$\% \text{ Reduction} = (1 - 0.00004/0.02758) \times 100$$

$$\% \text{ Reduction} = (1 - 0.00145) \times 100 = 99.8\%$$

An overall reduction of 99.8% for PCB is needed to achieve the TMDL goal.

### **Margin of Safety (MOS)**

Achievement of the TMDL will generally ensure achievement of the water quality criterion. To account for uncertainties that may be associated with the TMDL calculation, the Department proposes to hold 10% of the TMDL in reserve. Applying this 10% margin of safety results in a PCB TMDL of 0.0012839 pounds per day for allocation to all sources.

### **Wasteload Allocations (WLAs) and Load Allocations (LAs)**

No data is available on PCB concentrations in this segment of the Susquehanna River. For this reason, and because these are man-made compounds, natural and background concentrations are assumed to be zero.

No known existing or historic sources of PCB to this segment of the Susquehanna River were found during development of this TMDL. As a result, the Wasteload Allocation (WLA), the portion of the load contributed by point source discharges, is set to zero.

Because there are no known sources of PCB to this segment of the Susquehanna River, it is treated as a nonpoint source contaminant that may be introduced to surface water through contaminated ground water or surface runoff. As a result, the entire TMDL for PCB is assigned to the Load Allocation (LA), that portion of the load contributed by nonpoint sources. The Source Assessment notes that once in a water body, PCB becomes associated with soil particles and enters the sediments. Fish tissue contamination results from this sediment load. Because of this, the entire TMDL for PCB in this reach of the Susquehanna River, 0.0012839 pounds per day, is assigned to a Load Allocation for the stream sediment.

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### TMDL Summary

The TMDL for the Susquehanna River from the Route 92 bridge at Falls (RM 208.8) to the confluence of the West Branch (RM 125.5) can be summarized as follows:

TMDL Summary				
Pollutant	TMDL	WLA	LA	MOS
PCB	0.0014266 lbs/day	0	0.0012839 lbs/day	0.00014266 lbs/day

### TMDL Verification

The stated goal of this TMDL is to meet the PCB water quality criterion for the protection of public health in this reach of the Susquehanna River. Another way to state the goal is to reach a point where fish consumption advisories are no longer needed because tissue levels of PCB are no longer above the level of concern.

The three agencies involved with the issuance of fish consumption advisories in Pennsylvania currently apply the "Protocol for a Uniform Great Lakes Sport Fish Consumption Advisory" (commonly referred to as the Great Lakes protocol) for issuance of consumption advisories due to PCB. Following this method, meal-specific consumption advice is issued by species. The first level of consumption advice, eat no more than one meal per week, is issued when the tissue PCB concentration is 0.06 to 0.20 mg/kg. The upper limit for unrestricted consumption is 0.05 mg/kg. In order to verify the protectiveness of the PCB TMDL, the estimated fish tissue concentration that would be expected to accumulate at a water column concentration of 0.00004 µg/L was calculated. Reaching the PCB criterion would result in an estimated tissue concentration of 0.001 mg/kg, well below the 0.05 mg/kg level for unrestricted consumption.

### TMDL Implementation

PCB present in the main stem of the Susquehanna River is believed to reside primarily in the sediment due to historic use. Generally, the level of PCB is expected to decline over time due to the ban on use through natural attenuation. Examples of processes in natural attenuation are covering of contaminated sediments with newer, less contaminated materials, and flushing of sediments during periods of high stream flow. Natural attenuation may be the best implementation method because it involves less habitat disturbance/destruction than active removal of contaminated sediments. Mechanical or vacuum dredging removes the habitat needed by certain benthic macroinvertebrates. In addition, some of these organisms will be killed during the dredging process. Suspension of sediments during dredging may also cause abrasive damage to the gills and/or sensory organs of benthic macroinvertebrates or the gills of fish. Suspended sediments can also affect the prey gathering ability of sight-feeding fish. In addition, active removal may cause suspension of contaminated materials thus making PCB available for additional uptake. This alternative is, of course, also the least costly option.

### Monitoring

Pennsylvania will continue to monitor PCB in bottom feeding fish, walleye, and smallmouth bass in this reach of the Susquehanna River. Samples will be collected once every five years. The data will be used to evaluate the possible threat to public health and to determine progress toward meeting the TMDL.

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The consumption advisories will remain in place until the water quality criterion is achieved and advisories are no longer needed.